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Survival and growth of exponential and stationary phase *Salmonella* during fermentation of sausage

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Background and introduction

Raw meat will occasionally be contaminated with enteropathogens during slaughter. These pathogens will be transported further down the meat processing chain and may constitute a risk for the consumer.

During manufacturing of sausages, the majority of meat are frozen when mixed with ingredients during mincing. Freezing arrest bacterial growth and reduce the number of the pathogens. However, the production process of fermented sausages do not ensure complete elimination of pathogens.

The growth phase of bacteria in raw meat entering the sausage production is unknown. The survival and growth of *Salmonella* during fermentation may depend on its growth phase in the raw meat before freezing. Bacterial survival under food environmental stress are typically performed with stationary phase cells. However, the response to environmental changes differs between exponential and stationary phases cells, with stationary phase cells being generally more resistant.

Objectives

The objectives in this study were to:

- Investigate the survival of exponential and stationary phase cells of *Salmonella* Typhimurium phage definitive Types DT12 and U292 in minced meat during freezing.

- Follow survival/growth of exponential and stationary phase *Salmonella* during sausage fermentation with and without starter culture.

Conclusion

It can be concluded from the experiments that:

- The exponential phase cells are significant more sensitive to freezing than stationary phase cells.

- Growth of the starter culture during sausage fermentation arrest growth of both exponential and stationary phase cells.

- Fermentation failure (mimicked by not adding starter culture) may lead to *Salmonella* growth, most prominent for exponential phase cells.

Results

Effect of freezing on survival of exponential and stationary phase *Salmonella* Typhimurium DT12 and DTU292 in minced meat

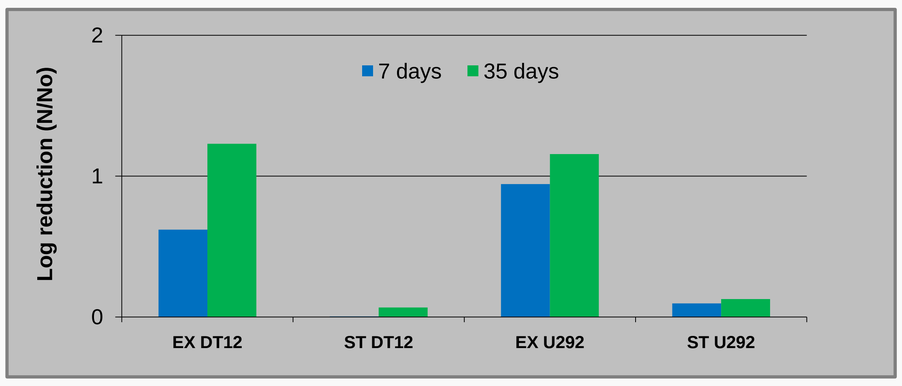


Fig 1. Significant differences in survival of exponential (EX) and stationary (ST) cells was observed during freezing in minced meat. No reduction was observed for the stationary cells after freezing for 35 days whereas exponential cells were reduced more than 1 $\log_{10}$.

Growth of exponential and stationary phase *Salmonella* Typhimurium DT12 during sausage fermentation

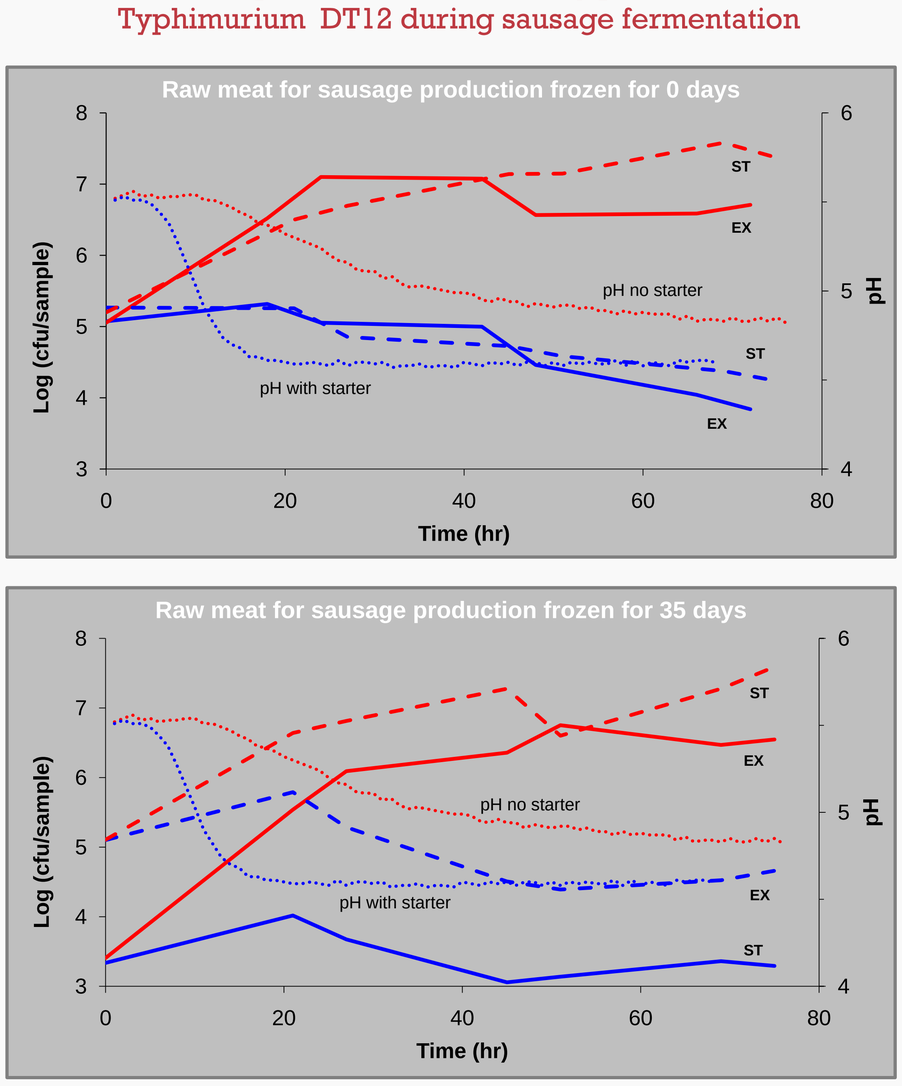
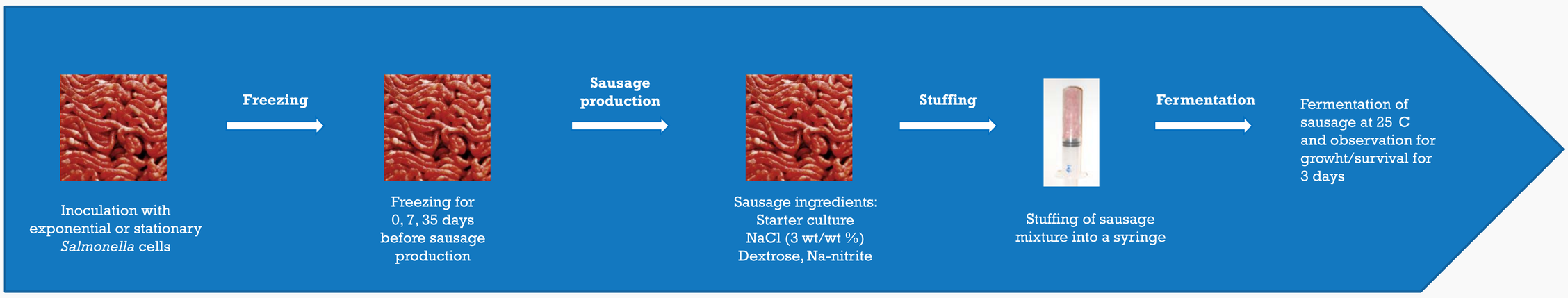


Fig 2. In the sausage without starter culture the stationary and exponential cells starts to grow where the exponential grows faster. Adding starter culture results in a drop in pH and a blocking of the growth of *Salmonella* in both growth phases.

Red curves: without starter culture Blue curves: with starter culture

Fermented sausage model

Reduction of Salmonella during freezing – growth/survival during fermentation



The sausage model was modified after Axelson, Nofima Mat, Norway